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FINAL REPORT:

NASA IUE grant NAG5--2103

IUE Monitoring of Long Period Eclipsing Systems, and Intersystem C II Lines as Shock Diagnostics in Stellar Chromospheres

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Report covering the period through 1996 Mar.31

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Final Report, NAG5-2103,
Covering the period from inception thru 3/31/95

Principal Investigator: Prof. R.E.Stencel, University of Denver

IUE Guest Observer Approved Projects, to date:
SC165 (1995/6): IUE Vilspa Observations of epsilon Aurigae (ESA).
LPRRS (1994/5): IUE Monitoring of Long Period Eclipsing Systems -- year 3 of 3.
LPPRS (1993): IUE Monitoring of Long Period Eclipsing Systems -- year 2 of 3.
SCPRS (1993): Intersystem C II Lines as Shock Diagnostics in Stellar Chromospheres, year 2.
LPORS (1992): IUE Monitoring of Long Period Eclipsing Systems -- year 1 of 3.
SCORS (1992): Intersystem C II Lines as Shock Diagnostics in Stellar Chromospheres.

PROGRESS SINCE THE INITIATION OF THIS GRANT:

This grant has completed the final 6 months of its no cost extension and expired 3/31/96. The grant funding actually started well after 15th episode data gathering began in June 1992. Some of the highlights are as follows:

A. 19th Episode Observing time awarded, ESA program SC165, to continue monitoring the long period eclipsing binary, epsilon Aurigae, during secondary minimum (95/96). Observations thus far include 10/95, 1/96. Planned for 4/96, 7/96.

B. 18th Episode Observing Time, LPRRS--
1. Awarded 4 US2 shifts for 94/95.
   Double shift (US1+2) used 19 Nov.94, remote obs.,
   Double shift used 20 April 95, remote obs.,
   Double shift used 6/21/95, remote obs.,
   Final double shift used 9/9/95 , remote obs.
2. Completed joint GHRS/IUE analysis of Cl Cygni spectra.
3. Reviewed lists of spectra obtained with IUE (see attached) and emphasized analysis of the following sources:
--epsilon Aurigae, in coordination with 19th episode and related observations during secondary minimum;
--VV Cephei, in support of upcoming HST observations of eclipse;
--eclipse data for zeta Aur (in conjunction with GHRS) and 31 Cygni;
--light curves for selected symbiotic stars (along with ROSAT)

--EG And, as followup on HST/GHRS observations.

C. 16th/17th Episode Observing Time, LPPRS and SCPRS--

1. Coordinated HST-IUE observation of Cl Cygni, Sep-Oct.93, with assistance of Alex Brown and Ken Carpenter, after relocation of the PI to a faculty job at U of Denver, 7/93, following a sabbatical year at the U of Michigan (during which 22 IUE shifts were used).
2. Coordinated shift with program VKPMC during 1994 late Feb and early March to extend C II and Mg II monitoring of alpha Tau and two other stars [SCPRS, 2 US1s and 3 US2s] successfully executed.
3. LPPRS shifts executed on 1994, 13 May US2, 15 June US2, 16 June US1,2, including deep SWP of Cl Cygni at quadrature.

D. Long Period Eclipsing Systems [LPORS]--

1. Used all assigned 15th episode shifts via successful remote observing shifts were performed from Ann Arbor MI (sabbatical location) on 1992 Aug07, Oct02, Nov05, Dec03, 1993 Jan01, Jan15, Feb07, Feb16, Feb27, Mar11, Mar15, Apr09, May03,May26, and initial LPPRS data acquired during shift trade, 1993 Sep12.
2. Some highlights of these sessions:
   -Continued phase coverage, Cl Cygni, long SWP-high observations
   -ROSAT coordinated observations during entire period (AO3 data).
   -Ingress phase, 31 Cygni, Dec.92, unusual spectrum.
   -HST coordinated observations, EG And and zeta Aur, Jan-Mar'93.
   -First re-observations of epsilon Aur since 1983 eclipse.
   -HST coordinated observations, Cl Cyg, Sep-Oct.'93.
3. Timely reduction and examination of data tapes made possible with continuing colloboration with student, Dan Potter at U of Colorado, while DU students began training (see below). AAS poster Jan.94 on VV Cep.
4. Submitted paper on coordinated IUE and HST data on EG And .

E. Intersystem C II Lines and Shocks in Stellar Chromospheres [SCORS]--

1. Successful remote observing shifts were performed from Ann Arbor, MI on 1992 Aug30, Aug 31, Sep03, Sep05, Sep12, Sep18, Sep26.\\
2. Some highlights of these sessions:
   -Success in obtaining 15 deep LWP exposures of alpha Tau and 9 deep LWP exposures of alpha Ori.
   -Reduction of data and report of results at 1993 Jan. AAS meeting (Phoenix), paper 36.03.

-Submitted A\&A Letter reporting results (see prev. grant report) and gave oral presentations concerning these observations at U of Denver, U of Michigan and U Western Ontario.

PUBLICATIONS CITING SUPPORT OF NAG5-2103:

1. ``TheSearch for Acoustically-driven Mass-loss in Evolved Stars"
R.Stencel, A.Brown, K.Carpenter, M.Cuntz and P.Judge
1992 Bull.A.A.S. 24 (paper 36.03).

2. ``Rapid Density Fluctuations in Evolved Stellar Chromospheres"
R.Stencel, A.Brown, K.Carpenter, M.Cuntz and P.Judge
1993 A\&A (Letters) submitted, withdrawn.

3. ``EGAndromedae: Radiation Blistering of a Red Giant Stellar Atmosphere"
R.Stencel, K.Carpenter, R.Robinson, B.Bopp and J.Aufdenberg
1995 P.A.S.P., submitted, being revised.

4. "The 1993 Eclipse of Zeta Aurigae"
R.Stencel and D. Potter
1993 Bull. A.A.S. 25 (Washington DC AAS meeting poster, Jan.94).

5. "GHRS and IUE Observations of the Symbiotic Binary, CI Cygni"
M.Jalakas, R.Stencel, K.Carpenter and R.Robinson
1994 Bull. A.A.S. 26 (Tucson AAS meeting poster), p.1345.

6. "Short Term Chromospheric Variability in alpha Tauri: Results from IUE Time Series"
M.Cuntz, B.Deeney, A.Brown and R.Stencel
1996 Astrophys.J. -- in press

7. "GHRS and IUE Observations of the Interacting Binary, CI Cygni"
M.Jalakas, R.Stencel, K.Carpenter and R.Robinson
1996 PASP in prep.

Thank you NASA
for the opportunities!
– Bob Stencel